Circuit Simulation Project

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Title of the project:

**Conversion of 4X1 Multiplexer to 3x1 Multiplexer Using eSim**

Theory:

Multiplexer is a combinational circuit that has maximum of 2n data inputs, 'n' selection lines and single output line. One of these data inputs will be connected to the output based on the values of selection lines.

Since there are 'n' selection lines, there will be 2n possible combinations of zeros and ones. So, each combination will select only one data input. Multiplexer is also called as Mux.

Whereas, 4x1 Multiplexer has four data inputs I_3, I_2, I_1 & I_0, two selection lines s_1 & s_0 and one output Y. Whereas, a 3x1 Multiplexer has three inputs, different than the usual form of 2^n input lines and 2 select lines.
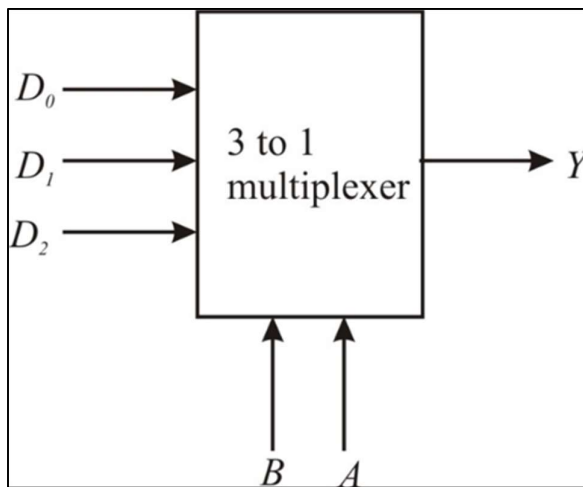
4x1 MUX:
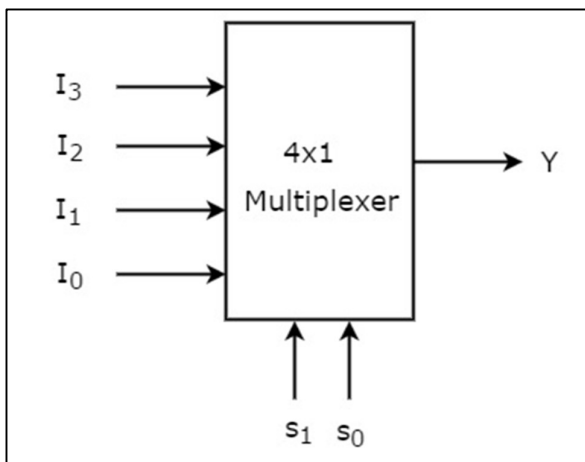
Truth table:

Selection Lines		Output
S_1	S_0	Y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

3x1 MUX:

Truth table:

Selection Lines		Output
S_1	S_0	Y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_2

To convert a 4x1 MUX to a 3x1 MUX, we need to add a NAND gate to the original 4x1 MUX circuit and give the select lines as the inputs, i.e., S0 and S1 and the output should be connected to the fourth input line I_3.
Therefore, the final circuit will have 3 input lines, I2, I1 & I0 and 2 select lines S0 and S1, i.e., a 3x1 MUX.
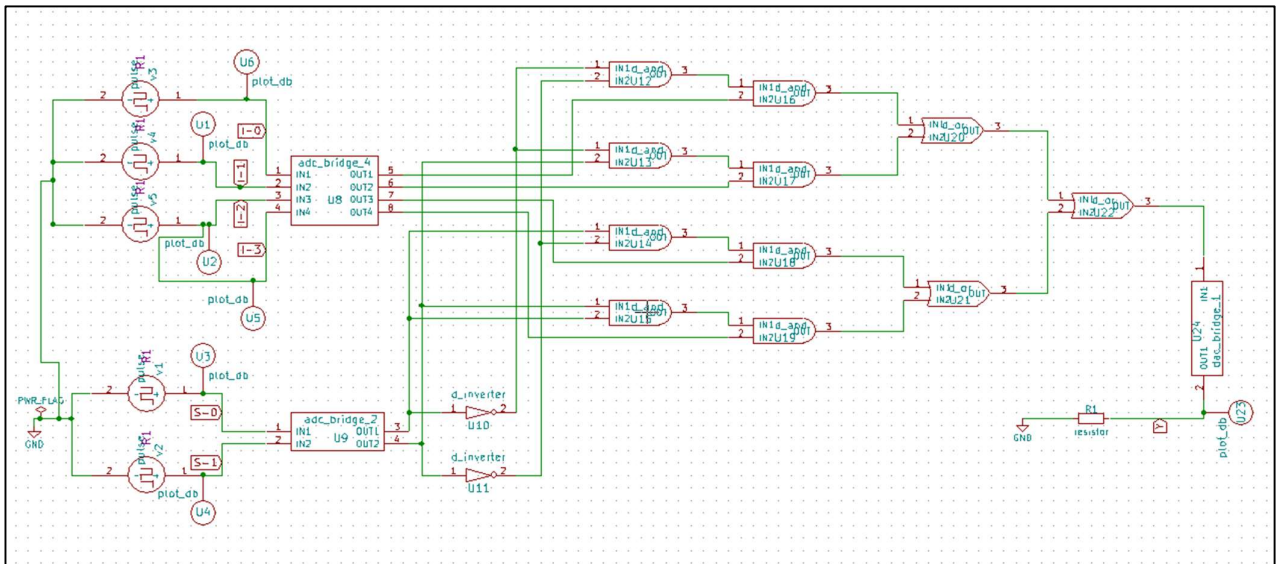

Circuit:

The circuit of the conversion of a 4x1 MUX to 3x1 MUX is shown below:
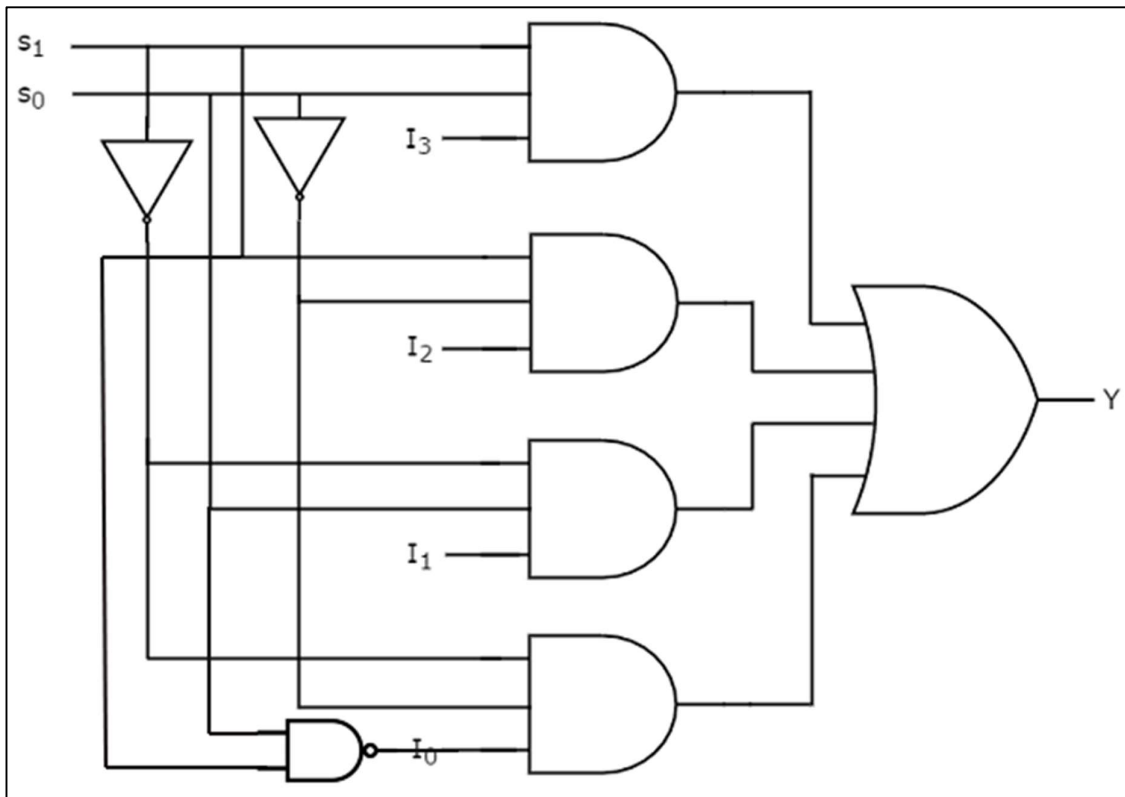
Schematic in eSim:

The circuit schematic of the conversion of a 4x1 MUX to 3x1 MUX in eSim is shown below:

Source and Analysis for Reference:

V1, V2, V3 , V4, V5:

Source Details

Add parameters for pulse source v3	
Enter initial value(Volts/Amps):	0
Enter pulsed value(Volts/Amps):	5
Enter delay time (seconds):	40
Enter rise time (seconds):	0
Enter fall time (seconds):	0
Enter pulse width (seconds):	40
Enter period (seconds):	80

Add parameters for pulse source v1	
Enter initial value(Volts/Amps):	0
Enter pulsed value(Volts/Amps):	5
Enter delay time (seconds):	160
Enter rise time (seconds):	0
Enter fall time (seconds):	0
Enter pulse width (seconds):	160
Enter period (seconds):	320

Tabs: Analysis | Source Details | Ngspice Model | Device Modeling | Subcircuits

Enter pulsed value(Volts/Amps):	5
Enter delay time (seconds):	160
Enter rise time (seconds):	0
Enter fall time (seconds):	0
Enter pulse width (seconds):	160
Enter period (seconds):	320

Add parameters for pulse source v2	
Enter initial value(Volts/Amps):	0
Enter pulsed value(Volts/Amps):	5
Enter delay time (seconds):	80
Enter rise time (seconds):	0
Enter fall time (seconds):	0
Enter pulse width (seconds):	80
Enter period (seconds):	160

Analysis:

Tabs: Analysis | Source Details | Ngspice Model | Device Modeling | Subcircuits

Select Analysis Type
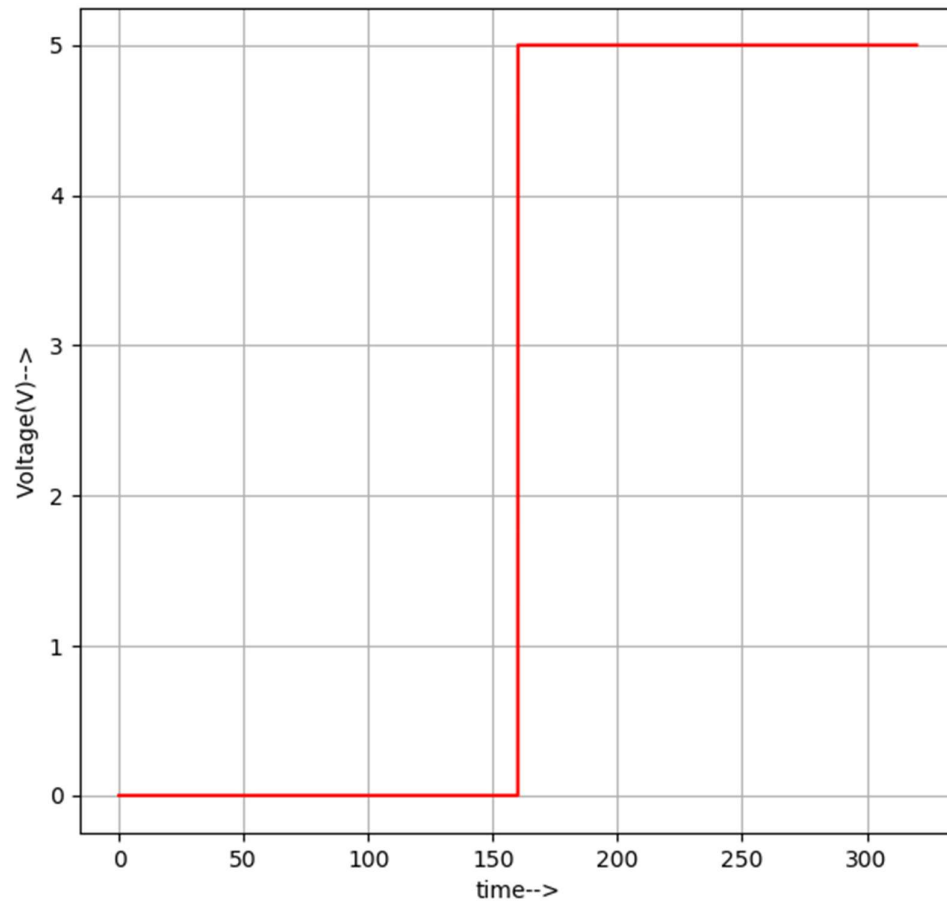
☐ AC   ☐ DC   ☑ TRANSIENT

Transient Analysis

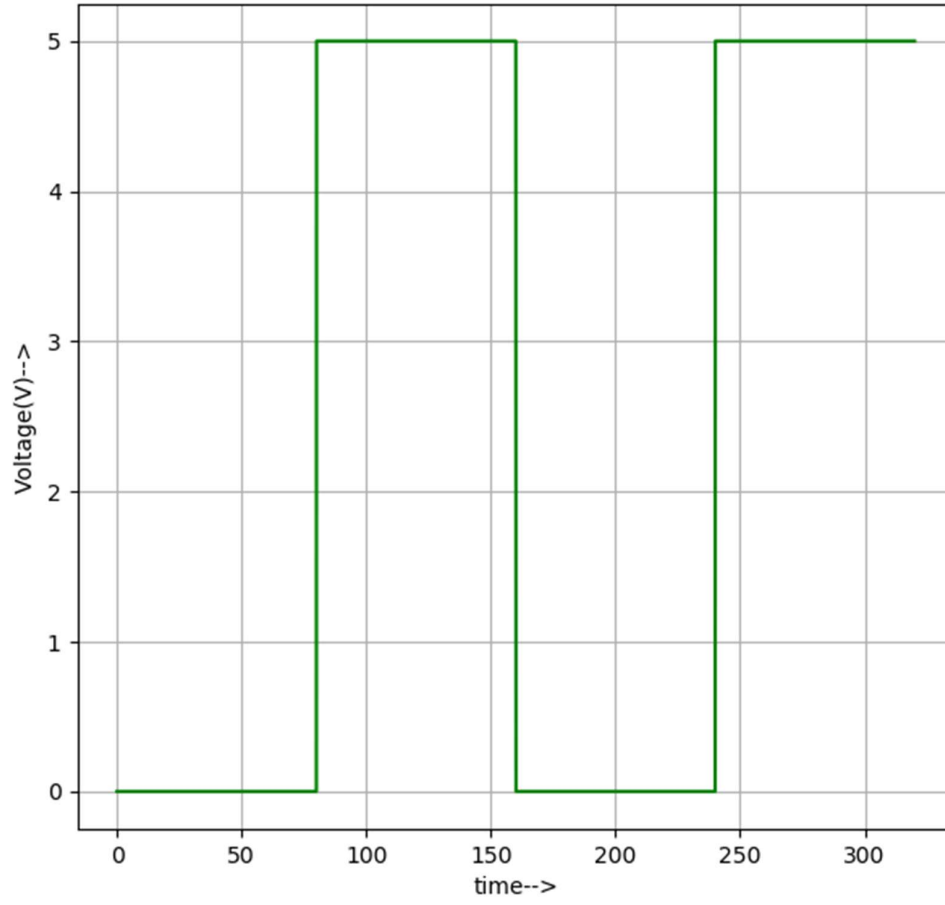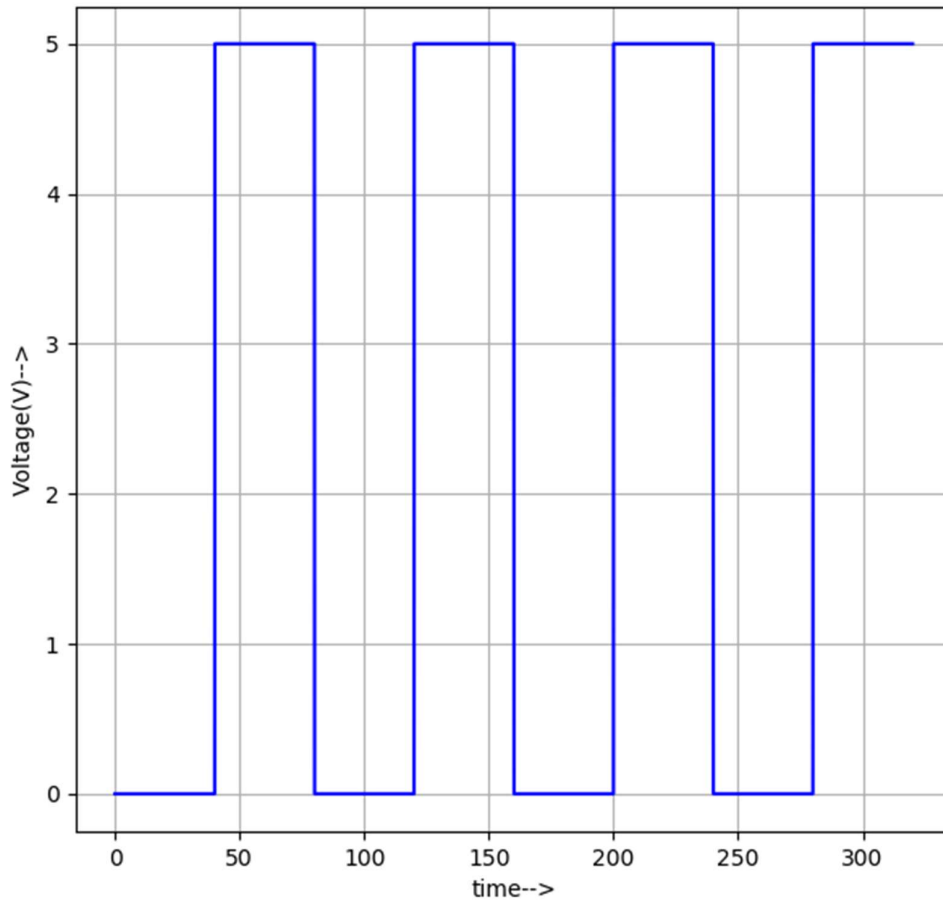| Start Time	0	Sec
Step Time	10	ms
Stop Time	320	Sec

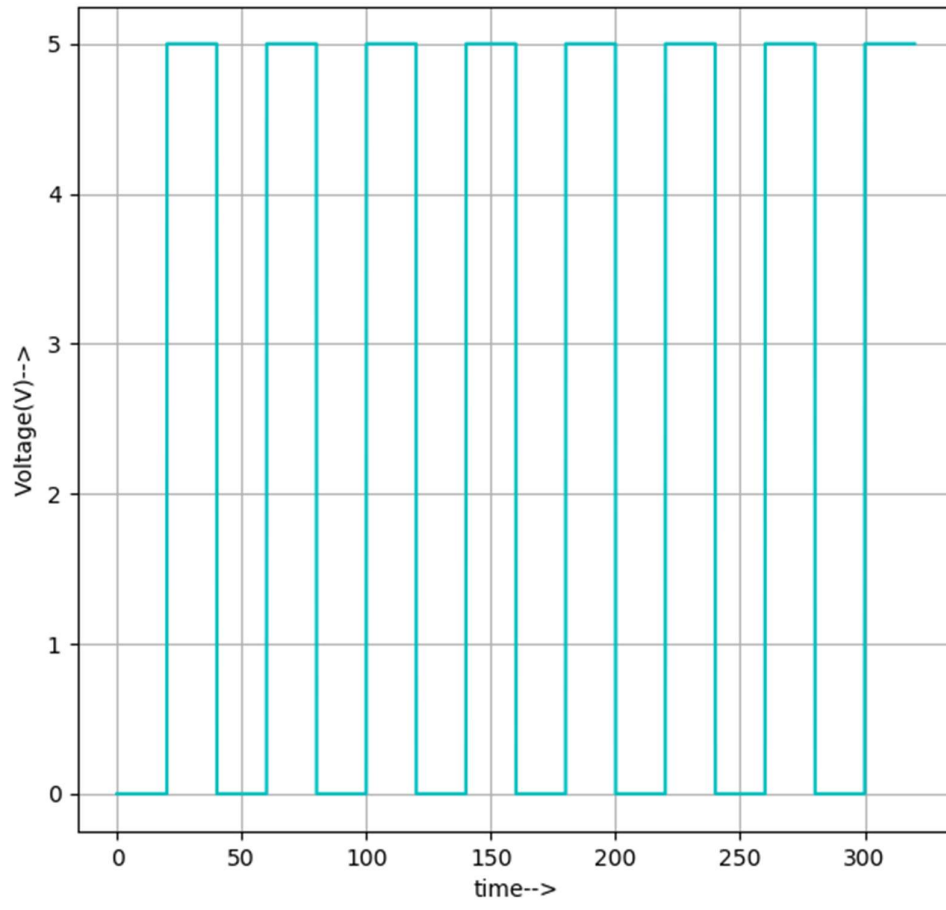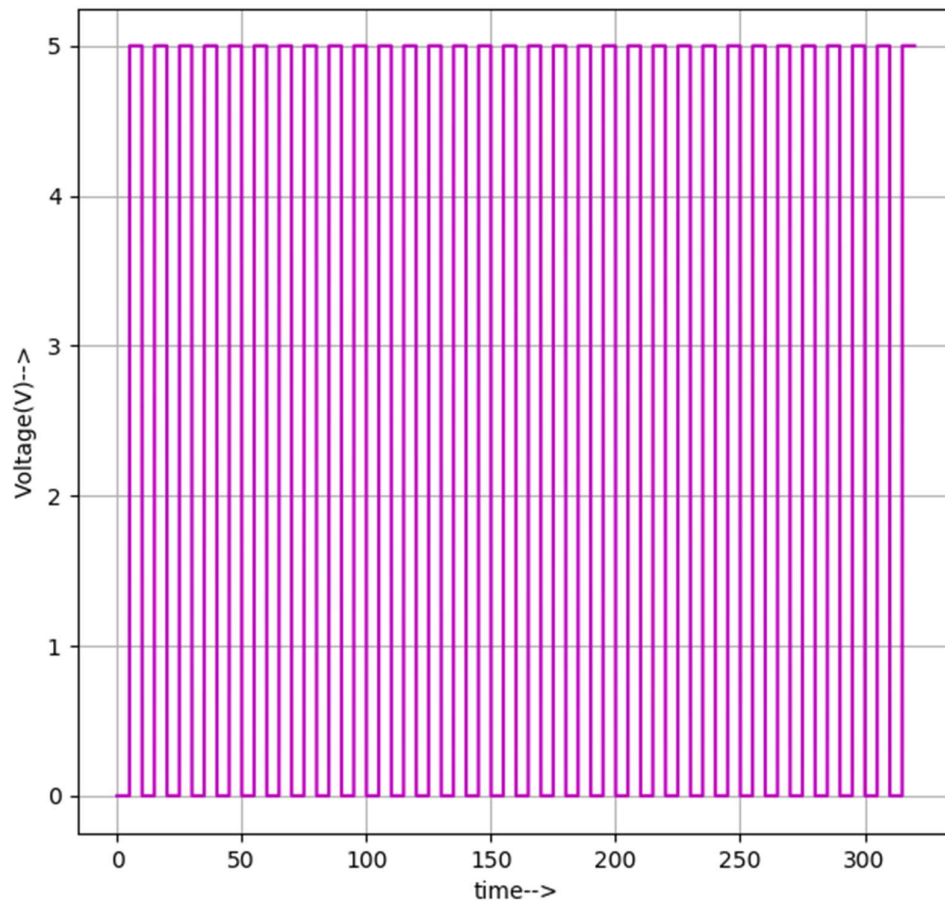**Simulation Results for the Schematic:**
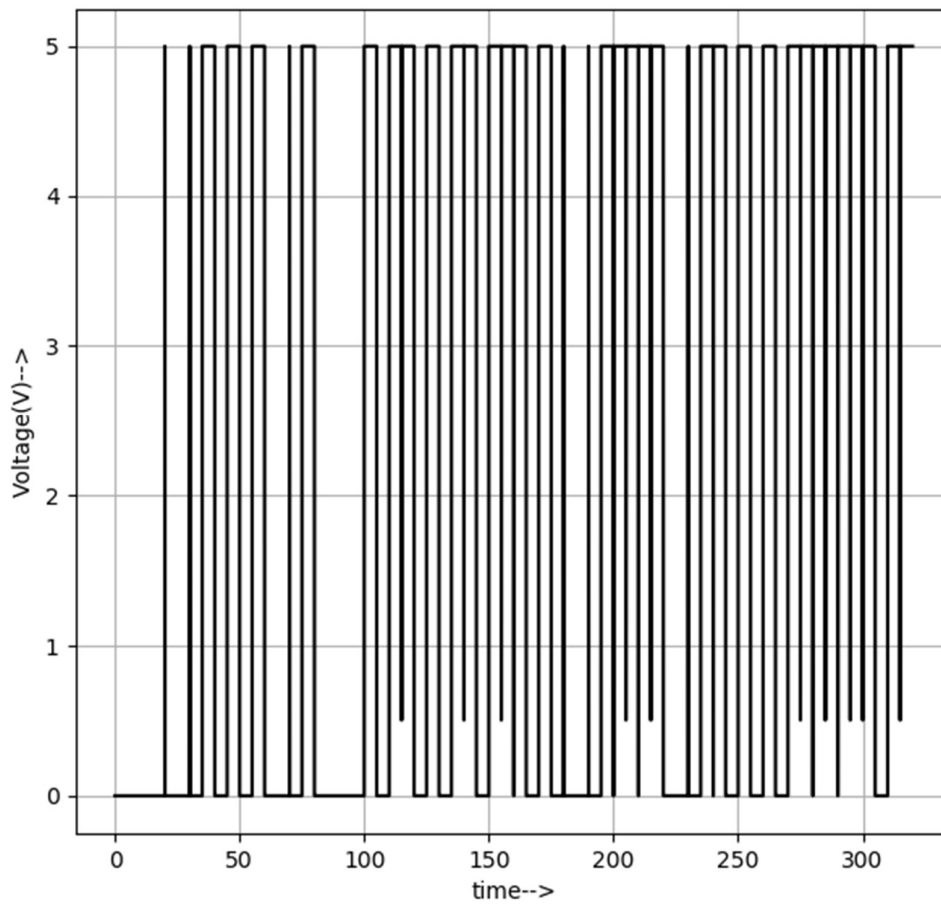
I-0:

I-1:

I-2:
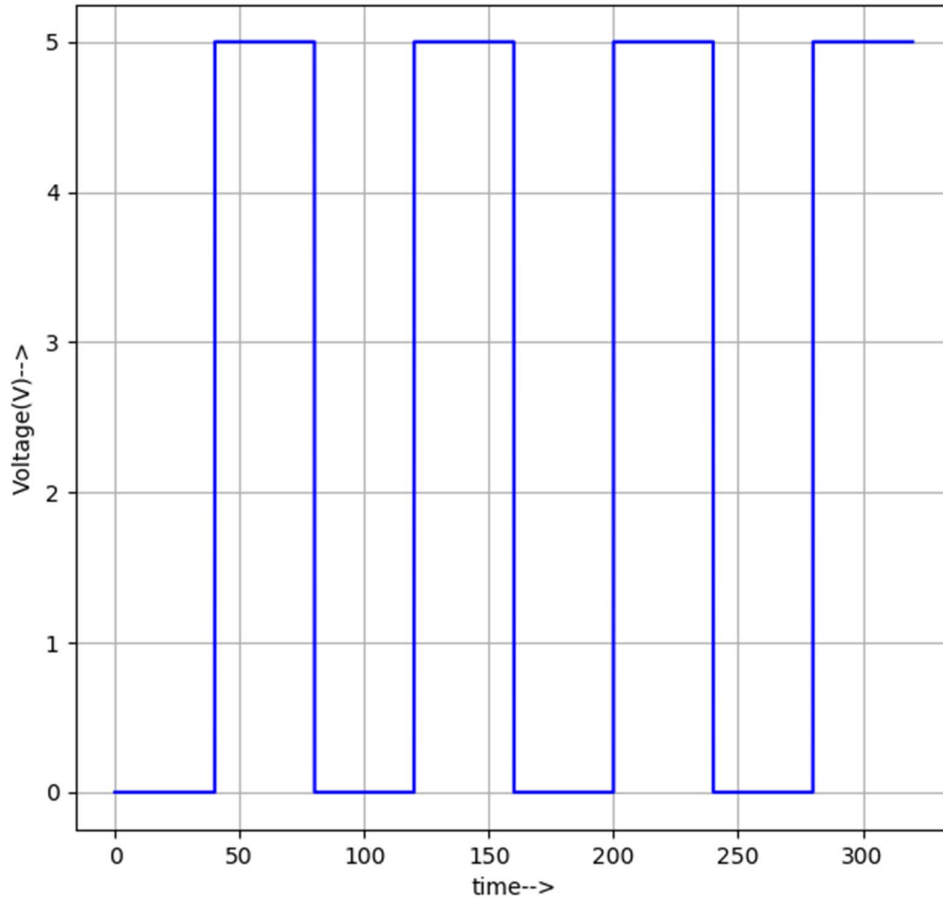
I-3:

S0:

S1:

OUTPUT:

Conclusion:

Thus, the circuit for conversion of 3x1 mux from 4x1 was made in eSim and its truth table was verified from the simulations.

Reference:

https://vlsiuniverse.blogspot.com/2016/07/multiplexer.html